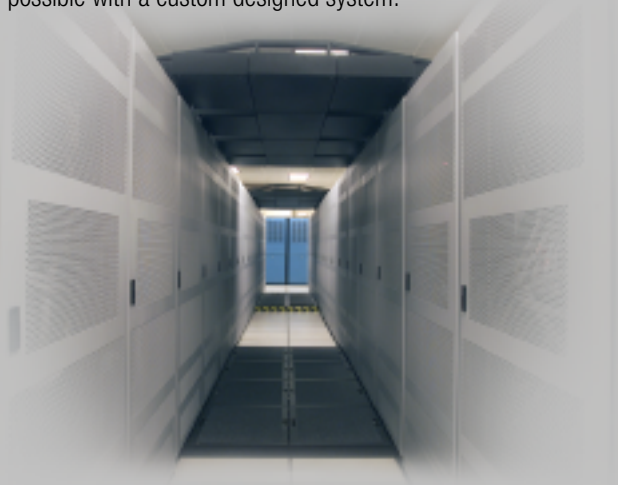
A Silicon Valley Partnership

NASA worked with two major Silicon Valley corporations, SGI and Intel, to build the Columbia supercomputer. This highly successful effort is based on proven results with last year's development of the world's first 512-processor Linux and Intel Itanium-based server, an SGI Altix located at Ames. Named Kalpana after Space Shuttle Columbia astronaut and Ames alumna Kalpana Chawla, this was one of the first 512-processor machines to be integrated into the Columbia supercomputer. Adding to this successful collaboration, engineers from Voltaire and Mellanox Technologies, Inc. provided ongoing support for the InfiniBand network infrastructure, and Cisco Systems provided state-of-the-art 10 gigabit Ethernet technologies. The standards-based architecture approach employed by SGI enabled Columbia to be built in far less time and for far less cost than would be possible with a custom designed system.



"NASA has a long history in supercomputing dating back to the origins of computational fluid dynamics in the 1980s. It is exciting to join with an industry team in this innovative venture that will change the very way in which science and simulation are performed by providing researchers with capabilities that, until now, they could only dream about."

— NASA Ames Research Center Director, G. Scott Hubbard

Columbia System Facts

Based on SGI® NUMAflex™ architecture
- 20 SGI® Altix™ superclusters, each with 512 processors
- Global shared memory across 512 processors

10,240 Intel® Itanium® 2 processors
- Processor speed: 1.5 gigahertz
- Cache: 6 megabytes

1 terabyte of memory per 512 processors, with 20 terabytes total memory

Operating Environment
- Linux® based operating system
- PBS Pro™ job scheduler
- Intel® Fortran/C/C++ compiler
- SGI® ProPack™ 3.2 software

Interconnect
- SGI® NUMAlink™
- InfiniBand network
- 10 gigabit Ethernet
- 1 gigabit Ethernet

Storage
- Online: 440 terabytes of Fiber Channel RAID storage
- Archive storage capacity: 10 petabytes

NASA Ames Research Center
Moffett Field, CA

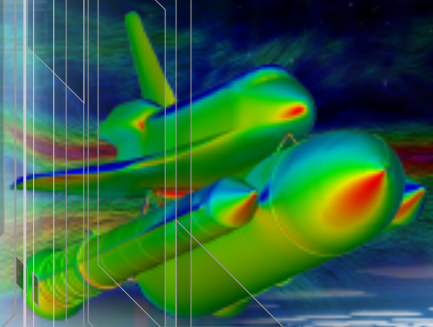
For more information visit: http://www.nas.nasa.gov

The *Columbia* System

NASA's Revolution in High-End Computing

The Columbia supercomputer is helping the NASA Advanced Supercomputing (NAS) Facility to fulfill it's mission:

To lead the country in the development and delivery of integrated, revolutionary, high-end computing services and technologies to facilitate NASA mission success



NASA's *Columbia* Supercomputer

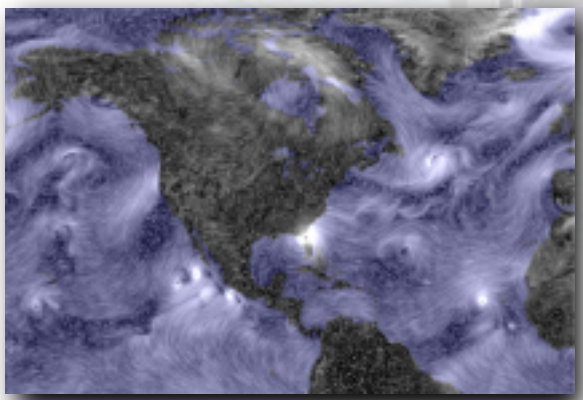
www.nas.nasa.gov

NASA's Columbia Supercomputer

One of the world's largest and fastest supercomputers is now up and running at NASA Ames Research Center in Silicon Valley, where a team at the NASA Advanced Supercomputing (NAS) Facility recently integrated 20 SGI Altix systems containing 10,240 Intel Itanium 2 processors. The new system, named Columbia in honor of the astronauts lost on the space shuttle, increases NASA's computing capability ten-fold and revitalizes the agency's high-end computing infrastructure.

This much-needed supercomputing resource delivered scientific breakthroughs even during construction. For example, using just a small portion of Columbia, scientists dramatically improved an important atmospheric code, the Finite Volume General Circulation Model (fvGCM), developed at NASA's Goddard Space Flight Center. Preliminary results indicate that this improved software can more accurately forecast hurricane paths five days ahead of time–an advance of three days over previous prediction windows.

Surface speed of the atmosphere for five-day hurricane forecast run using fvGCM

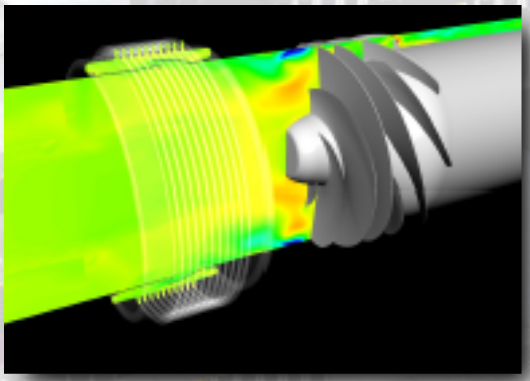


"NASA is excited to be working with industry in an innovative way to allow the agency to deploy a versatile capability in supercomputing. This will enable NASA to meet its immediate mission-critical requirements for Return to Flight, while building a strong foundation for our space exploration vision and future missions."

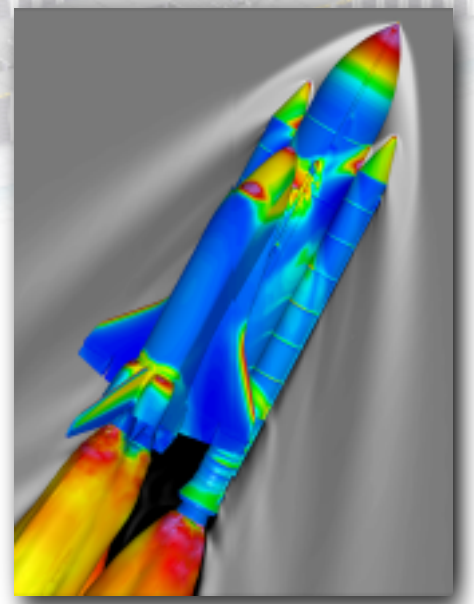
— NASA Administrator, Sean O'Keefe

The Columbia system is also having a significant impact on other important NASA missions, including the Return to Flight (RTF) activities. Among the critical RTF tasks, Columbia is performing highly complex calculations for the design and analysis of an entire fuel supply system on a liquid rocket engine. Much of the RTF work performed on Columbia focuses on improving the safety of space flight.

Fuel liner analysis conducted for the NASA Engineering Safety Center and Return to Flight program

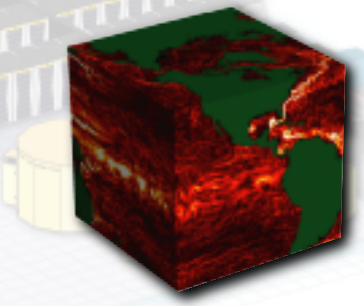


Shuttle ascent simulation and modeling



Monumental Construction Project

Columbia's first two 512-processor systems were delivered in late June 2004 and were integrated and operational within days–immediately doubling the computing capacity at the NAS Facility. The remaining systems were installed at an unprecedented rate and made available to scientists throughout construction in August, September, and October. Keeping to a very tight schedule, NASA was able to not only aggressively support the NASA Engineering and Safety Center and shuttle Return to Flight goals, but to continue enhancing other critical science and engineering work. The last system arrived in mid-October 2004, and the full Columbia system was built, integrated, and running full system benchmarks by late October.



Surface speed of the ocean on a unique "cube-sphere" grid for accurate depiction of the poles

Lasting Benefits

The Columbia supercomputer makes it possible for NASA to achieve breakthroughs in science and engineering for the agency's new Vision for Space Exploration. NASA scientists will be able to make rapid strides in the space and life science arenas, mission safety, aeronautics, and Earth sciences. One of the first problems tackled on Columbia, for example, was a new high-resolution ocean model used to predict global climate changes.

In addition, Columbia's highly advanced supercomputing architecture will be made available to a broader national science and engineering community. For instance, in conjunction with Boeing, NASA engineers are using Columbia to run high-resolution, full-body simulations of an advanced aircraft design, to evaluate its performance under a full range of flight conditions. Until recently, this large computation would have taken years to achieve–with Columbia, it now runs within a matter of days.